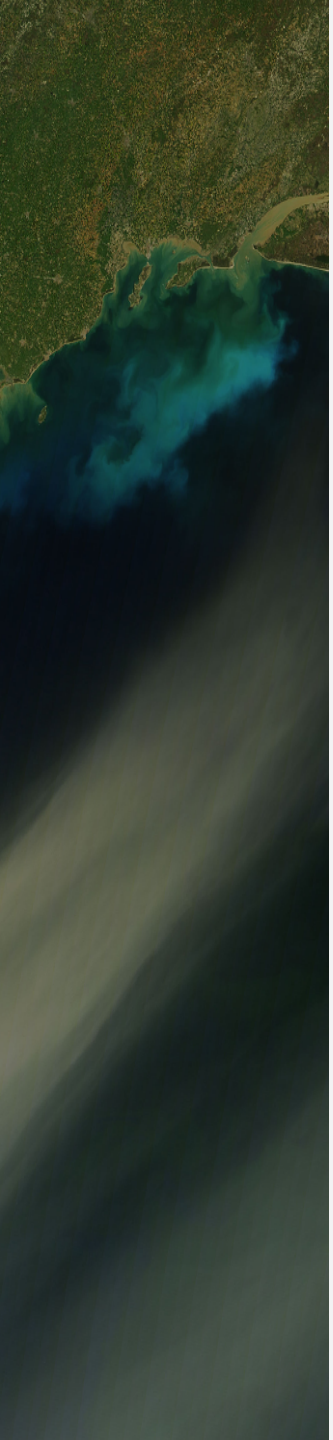


National Aeronautics and Space Administration

ARSET

Applied Remote Sensing Training

http://arset.gsfc.nasa.gov

@NASAARSET

How Can Health Professionals Use NASA Data: Acquiring and Using Environmental Data for Health Applications

Maury Estes

University of Alabama in Huntsville/NASA MSFC

June 1, 2017

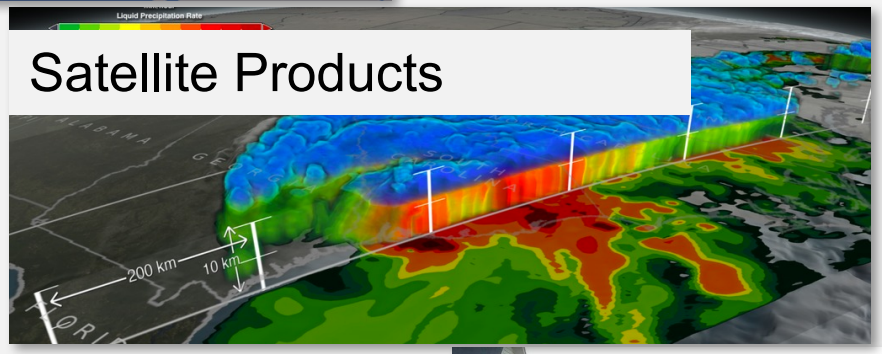
Outline

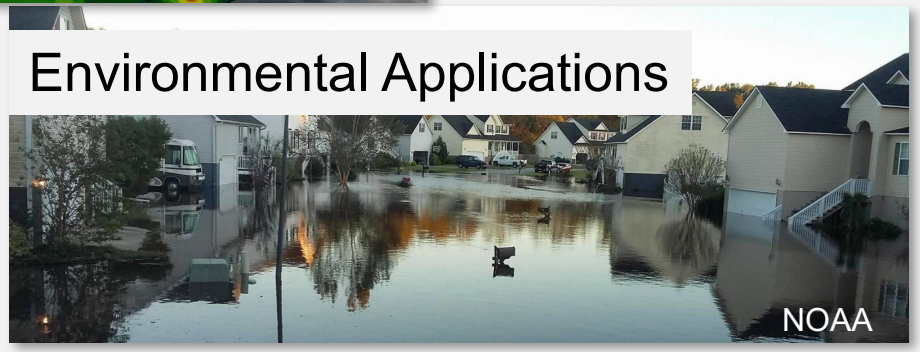
- Working with the Environmental Public Health Community
- Project Examples
- You have a health issue and want to determine if remote sensing data can be beneficial
- Acquiring remote sensing data
- Acquiring health data
- Linking remote sensing and health data
- Homework

Challenges Working with the Environmental Public Health Community (International & Domestic)

- Sharing data between agencies with different missions and mindsets
- Protecting confidentiality of information
- Ensuring high quality geocoded data
- Ensuring appropriate spatial and temporal resolution of environmental data
- Developing sound resources and methods for conducting data linkages and data analysis

Observations to Applications

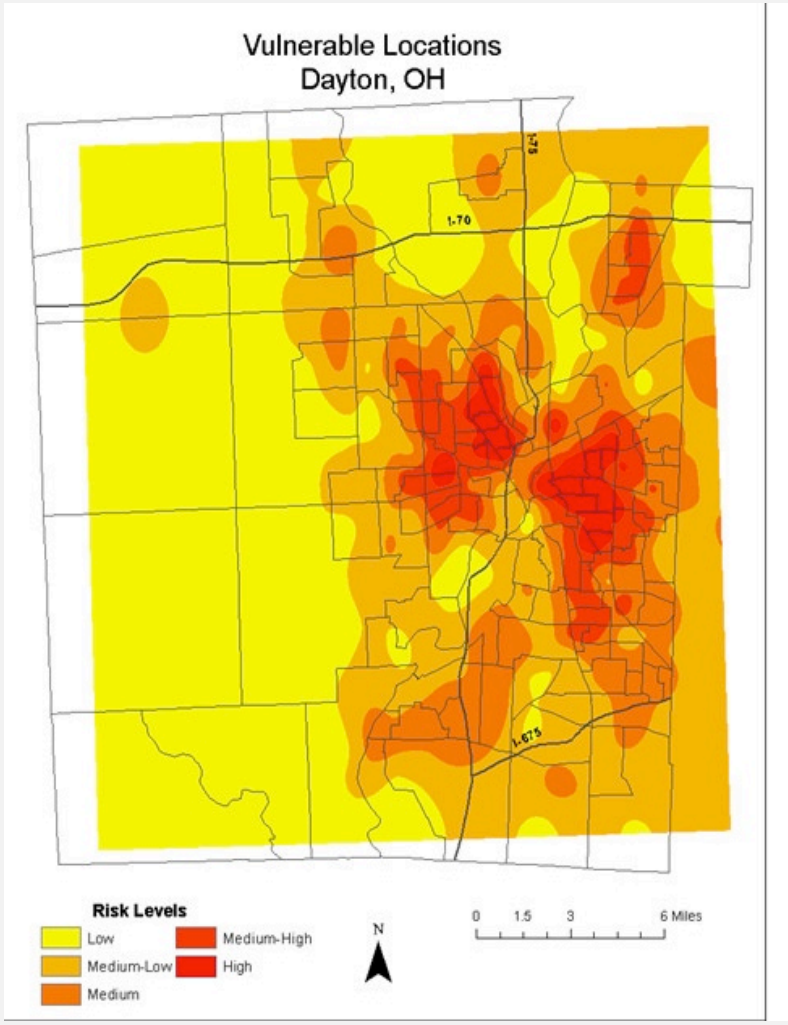




Examples of Data Applications

Environmental Public Health

- Remote sensing and modeling data, along with other sources of data, are used for a variety of applications, either:
  - directly
  - in statistical or physical modeling tools
- Remotely sensed data can be used:
  - to identify the hottest areas
  - improve identification of locations most vulnerable during extreme heat events

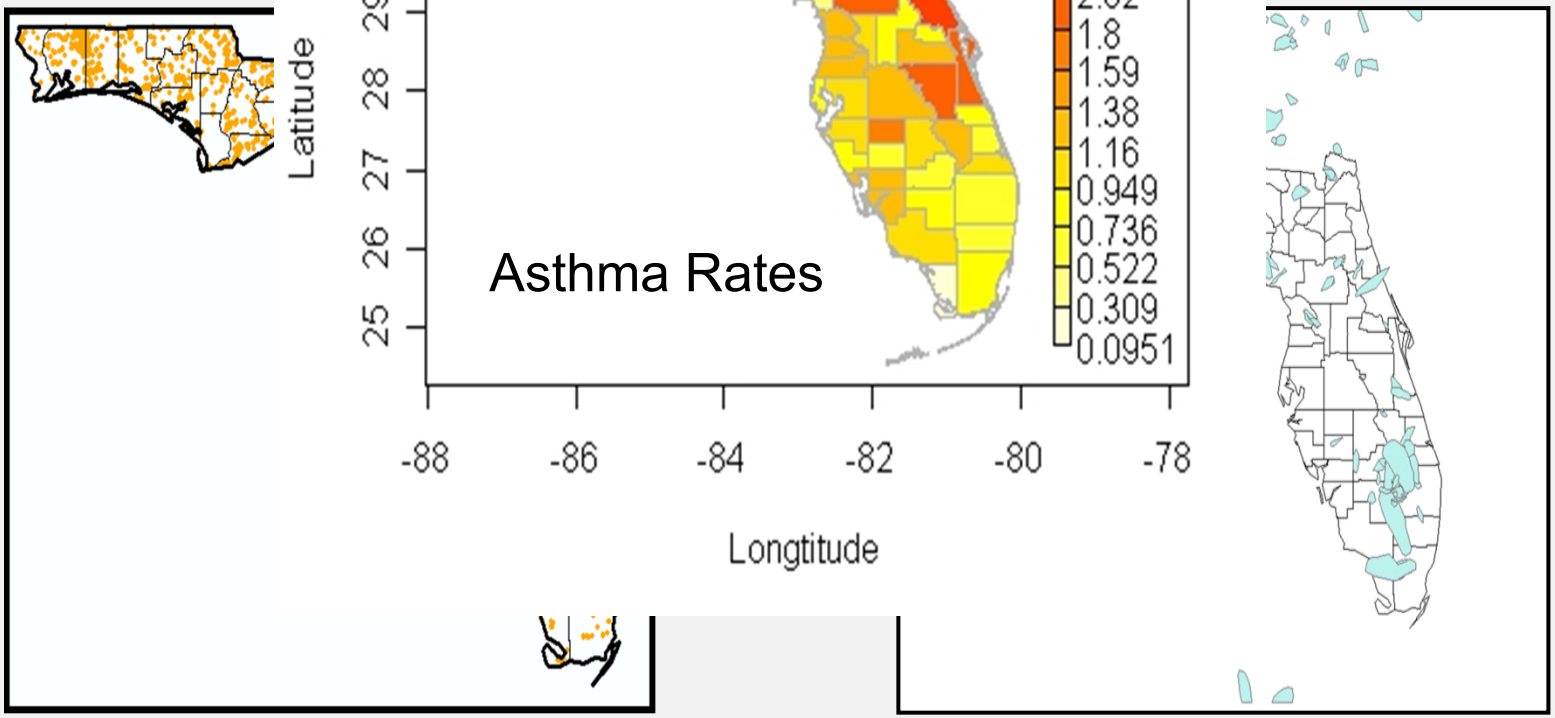


Examples of Data Applications

Fires, Smoke, and Public Health

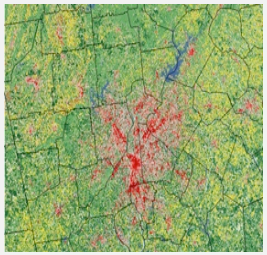
- This environmental data can be combined with public health data to evaluate the eff a or other U.S. regions

2007 MODIS **oke Plumes**

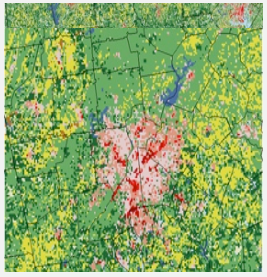


Examples of Data Applications

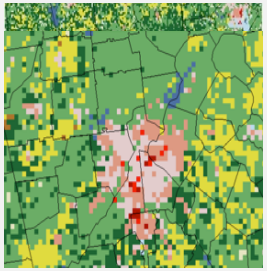
Relationship Between Living Environment and Blood Pressure



Landsat 30 m

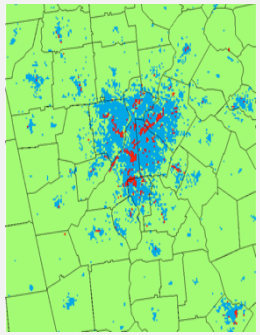


Landsat 1 km



Landsat 3 km

Landsat data was used at the native resolution of 30 m and resampled at other resolution to determine the optimal scale to distinguish urban, suburban, and rural living environments in the metropolitan Atlanta region



Living Environment	Mean SBP	Mean DBP
Urban	131±0.54	78±0.31
Suburban	127±0.42	77±0.24
Rural	127±0.76	76±0.44
p-Value	*<0.0001*	*>0.0001*

Health Problem

- What question or questions are you trying to answer?
- What type environmental data products do you need that NASA could provide?
  - Land Cover/Land Use: blood pressure
  - Vegetation Extent: urban heating/heat stroke
  - Slope: natural disasters/landslides
  - Air Quality: respiratory illnesses
  - Water Quality (fresh or marine): red tides, respiratory, gastrointestinal illnesses
  - Precipitation: flooding and disasters
  - Soil Moisture: mosquito, vector borne diseases
  - Land Surface Temperature: extreme heat

Acquiring Remotely Sensed Data

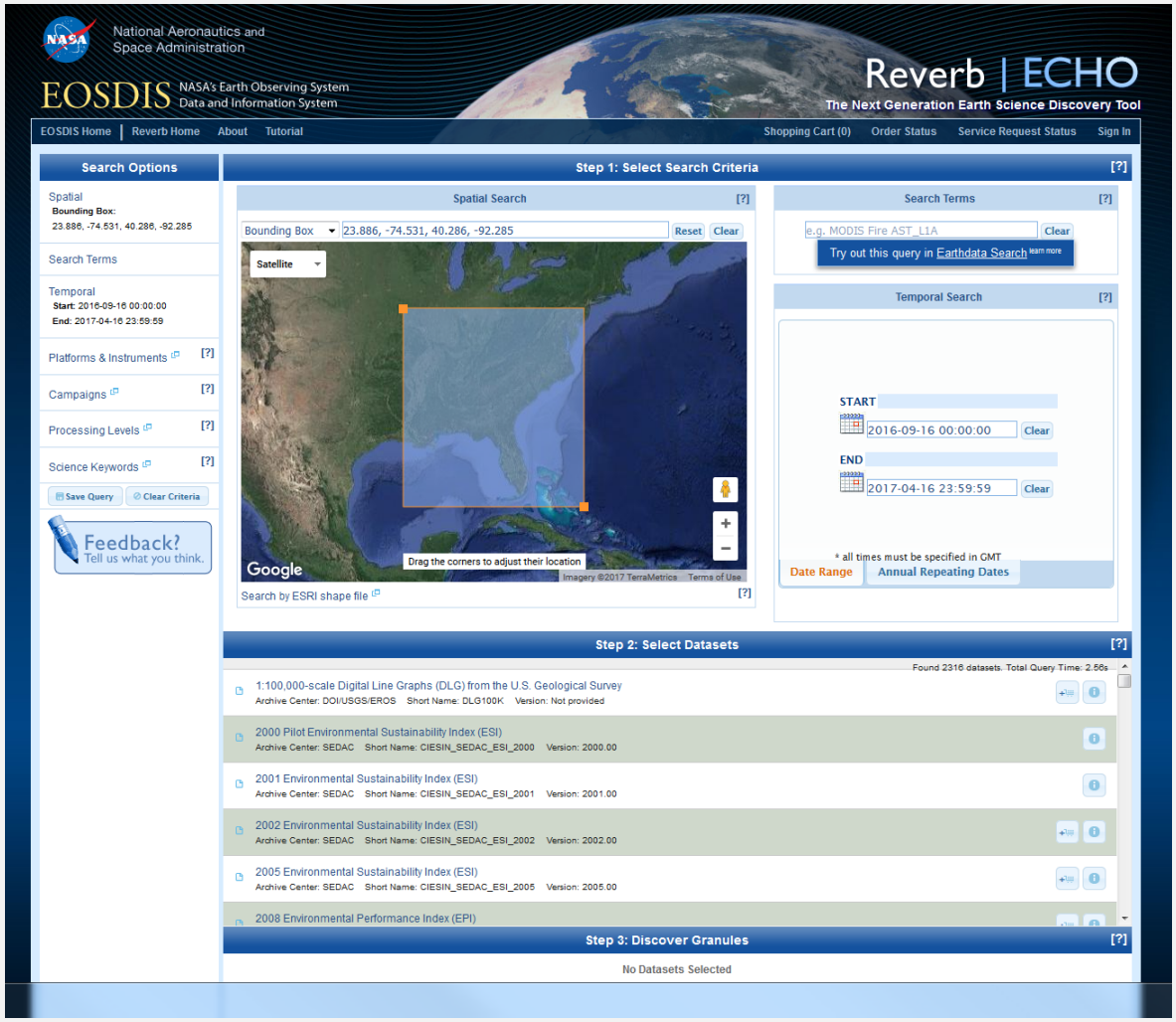
- NASA
  - Reverb – ECHO NASA https://reverb.echo.nasa.gov/reverb
  - EARTHDATA (EOSDIS)
    - Browse and download processed data
- USGS
  - Global Visualization Viewer (GloVis)
  - Earth Explorer (USGS)

Reverb

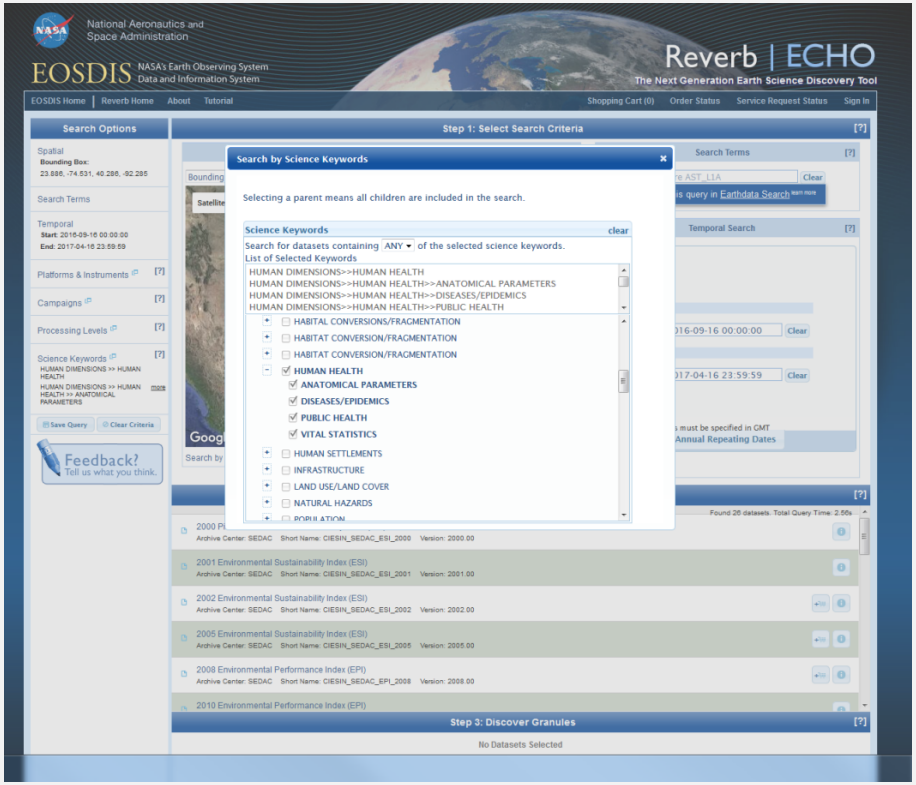
http://reverb.echo.nasa.gov/reverb/

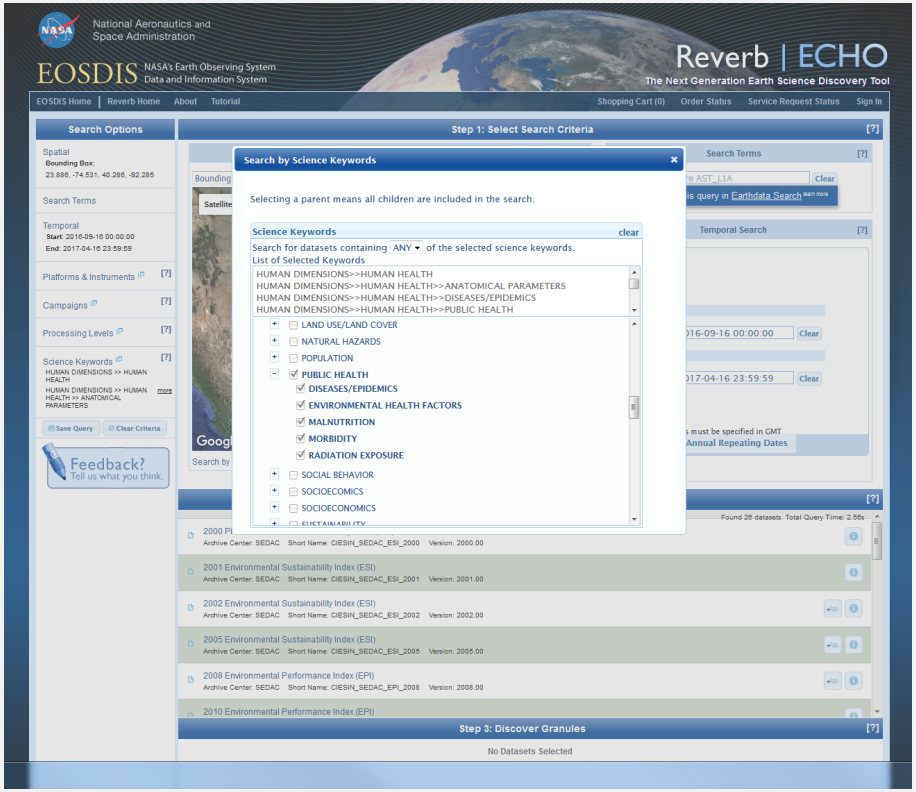
- Next generation metadata and service discovery tool
- Developed using modern web development technologies and presents you with an interface for discovering Earth Science data
- Updated on a monthly basis taking into account your user feedback and other, currently planned enhancements

Spatial & Temporal Search

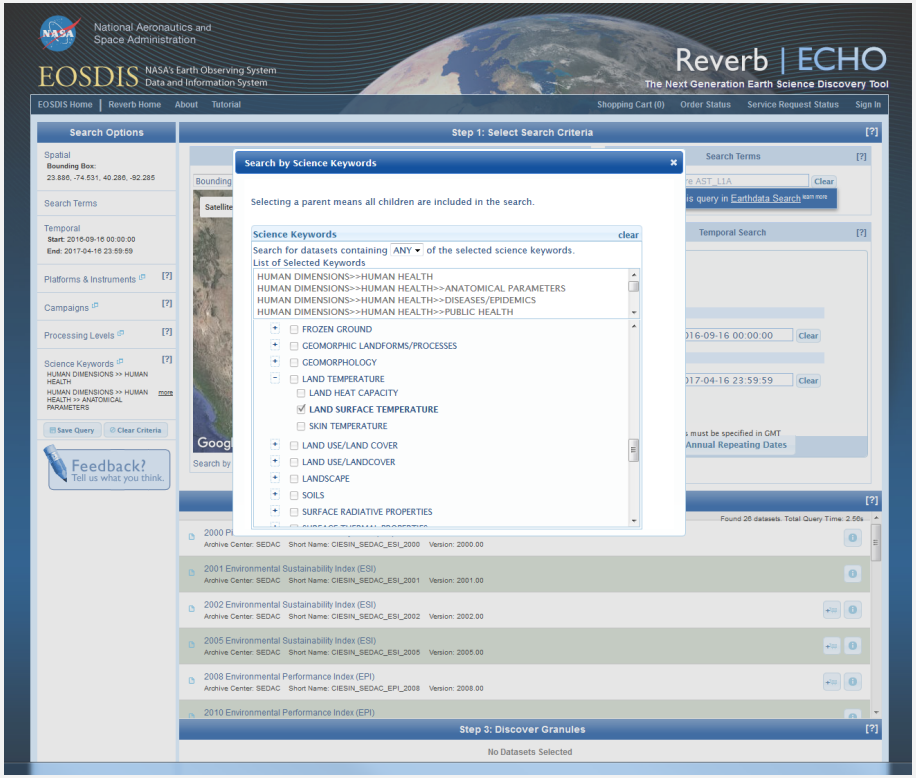


Science Key Words

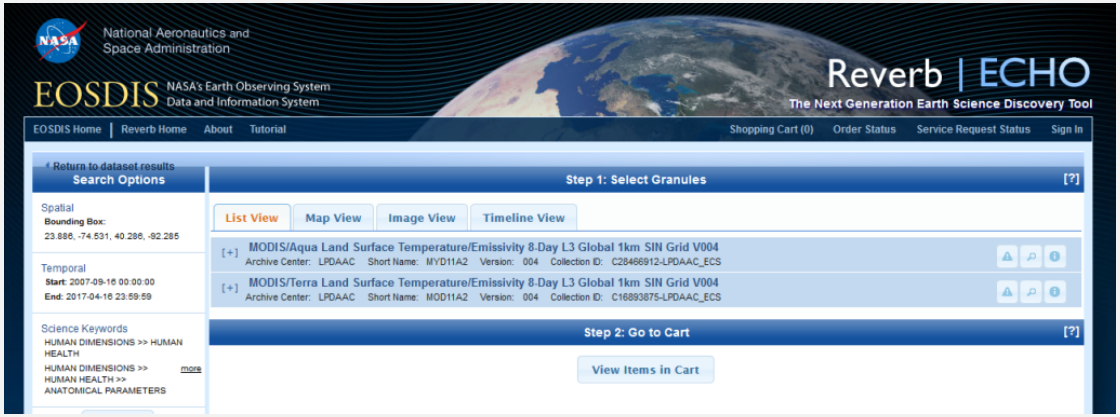


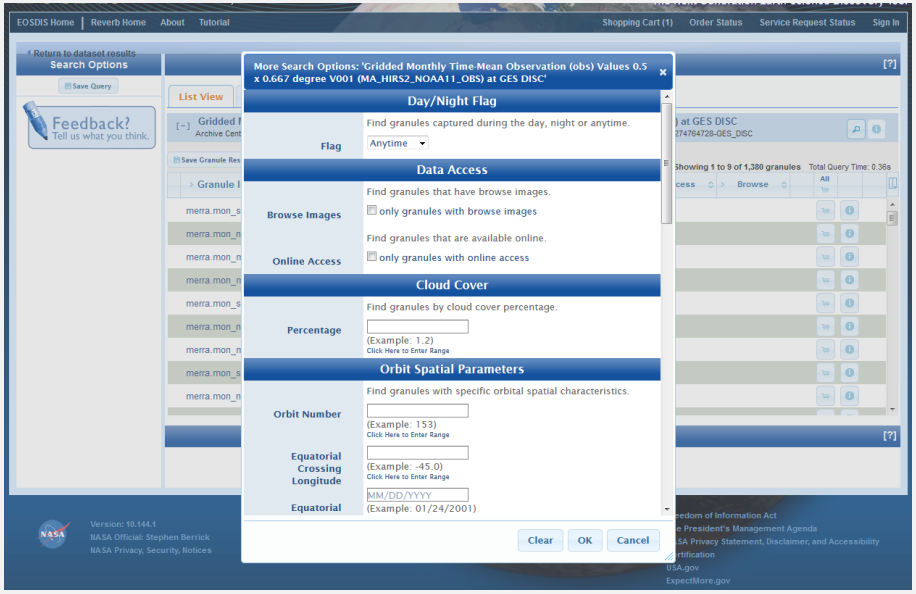


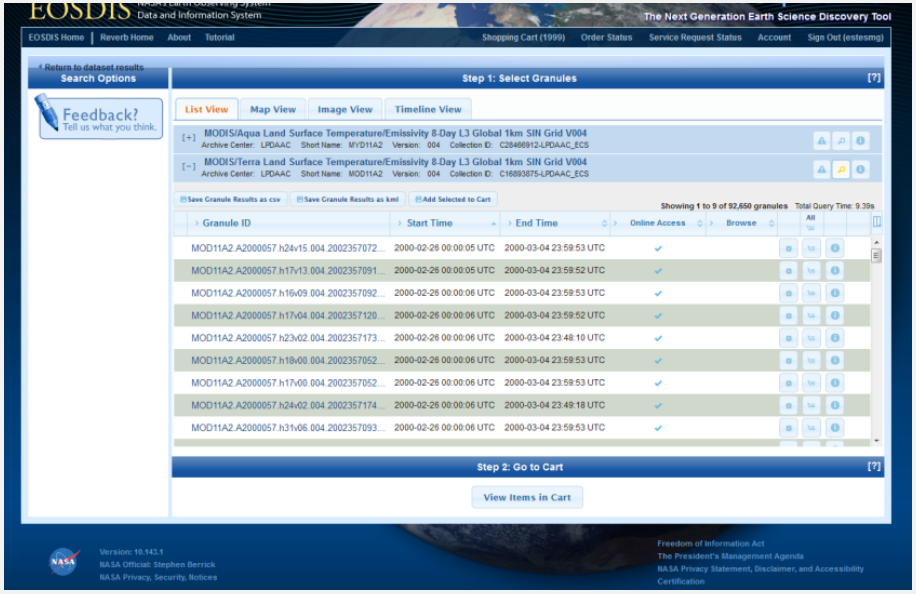
Science Key Words



Granule Results

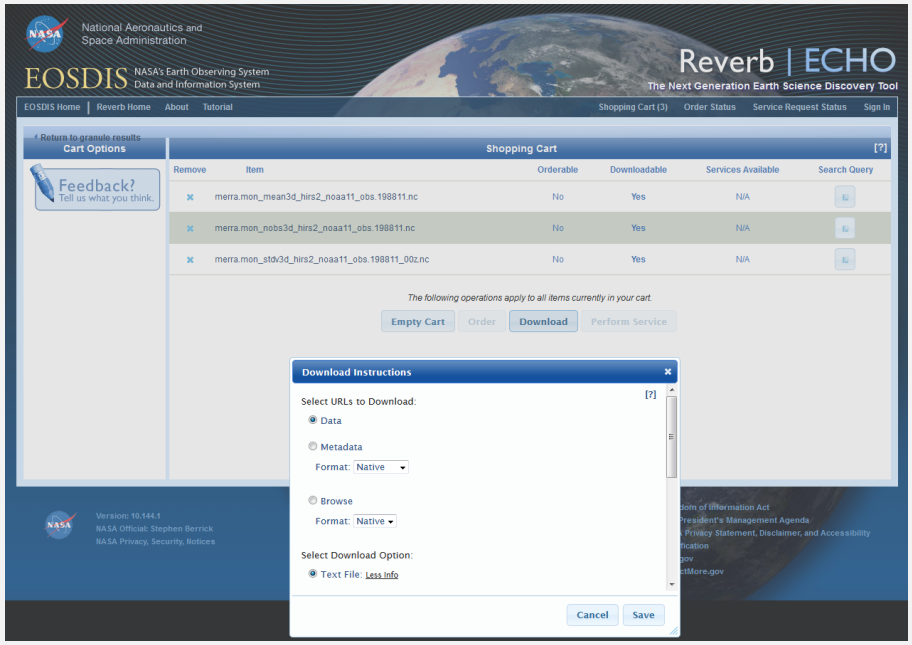






Ordering Granules

- Click on shopping cart icon to retrieve files of interest
  - Order, download or request services
- Using as a guest requires completion of a form each time. If you have an account this will not be needed
- Submit order to begin processing
- Will get order tracking number by email
- ftp links will follow for data download



- HDF format is ingestible into ArcMap/QGIS without data conversion to a geotiff

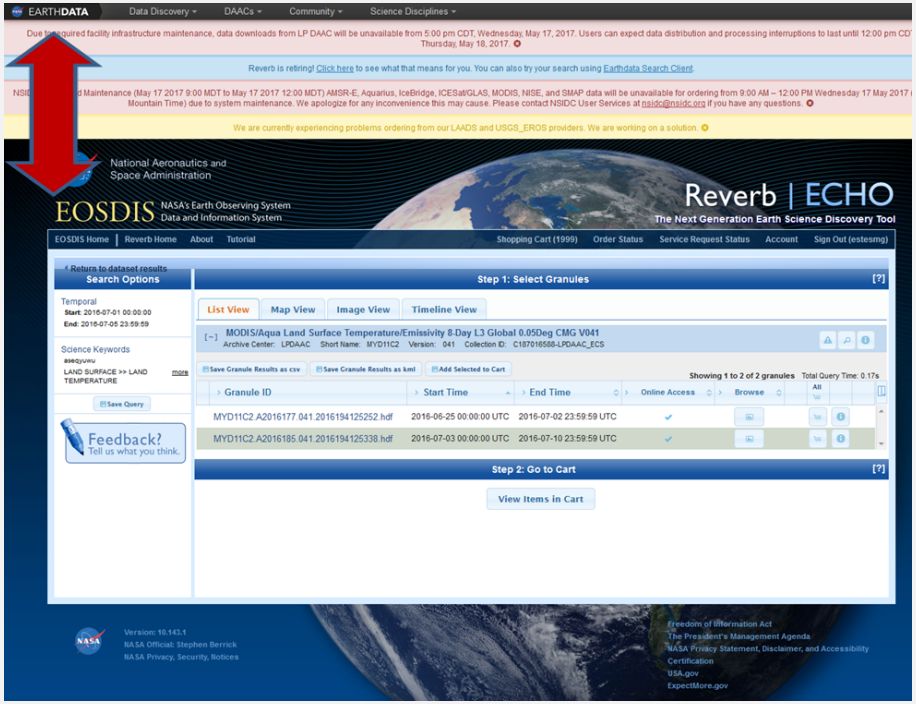
REVERB Data Retrieval and Ordering Overview

- Search for data using temporal and spatial constraints, specific data attributes, and processing levels
- Use map to drag a bounding box over the region of interest
- Platform and instrument search options menu
- Use calendar widget to set temporal range
- Can add keyword using text field
- When finished, click “search for granules” radio button
- Select granules for shopping cart and order

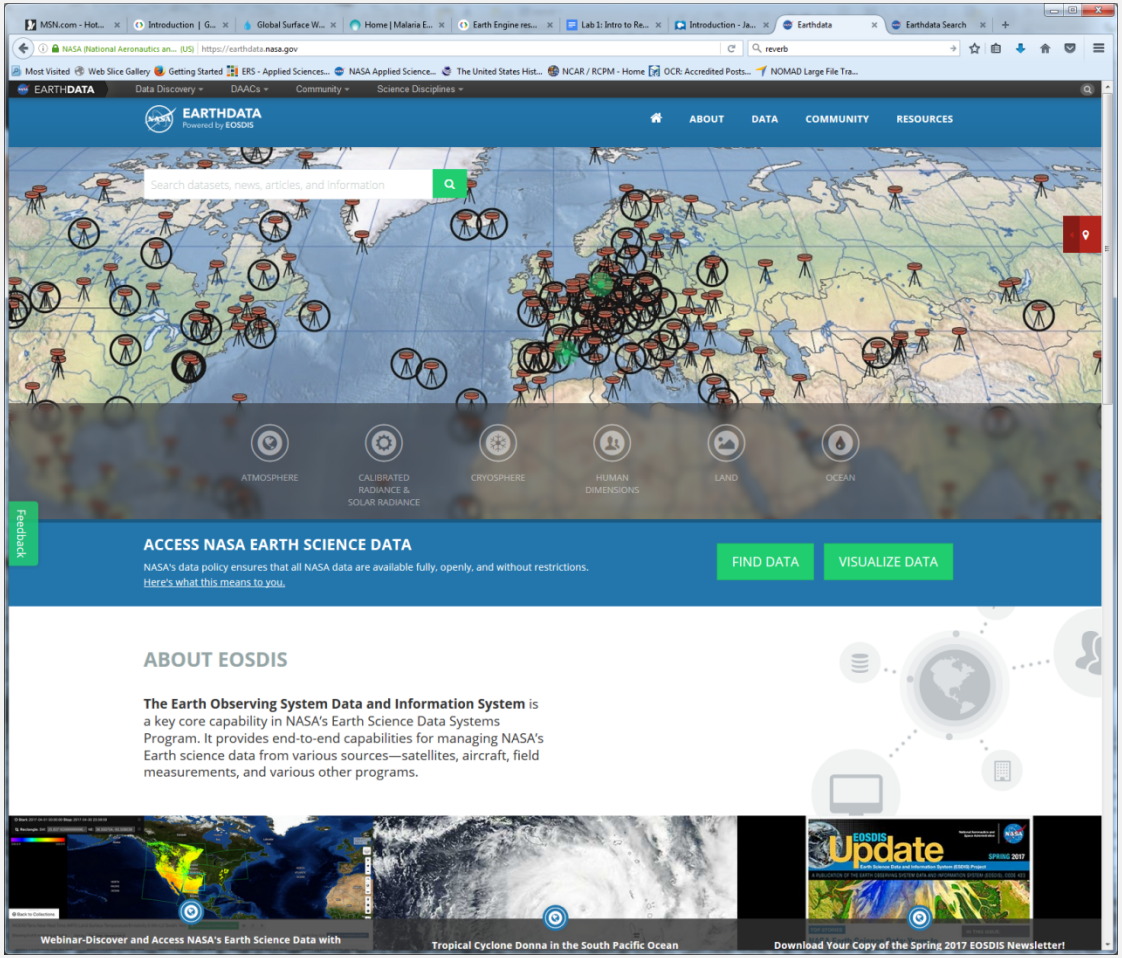
Earthdata

http://earthdata.nasa.gov/

- The Earth Observing System Data and Information System (EOSDIS) is a key core capability in NASA's Earth Science Data Systems Program
- It provides end-to-end capabilities for managing NASA's Earth science data from various sources
  - satellites
  - aircraft
  - field measurements
  - various other programs



Earthdata


EARTHDATA
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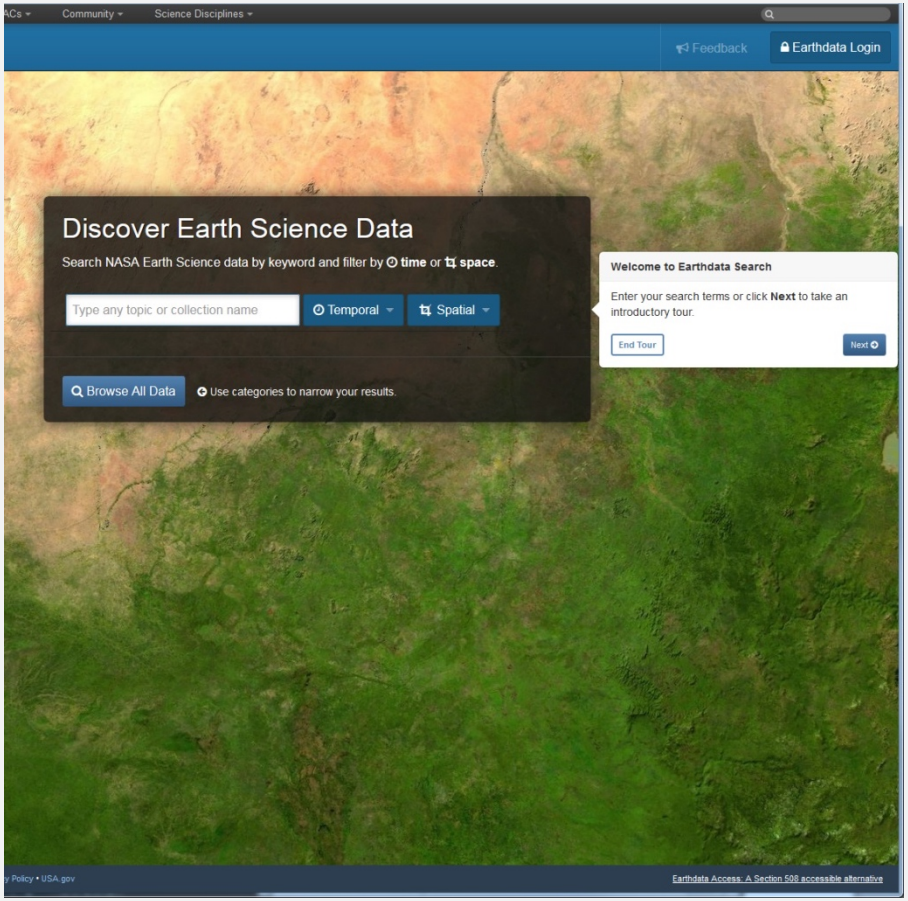
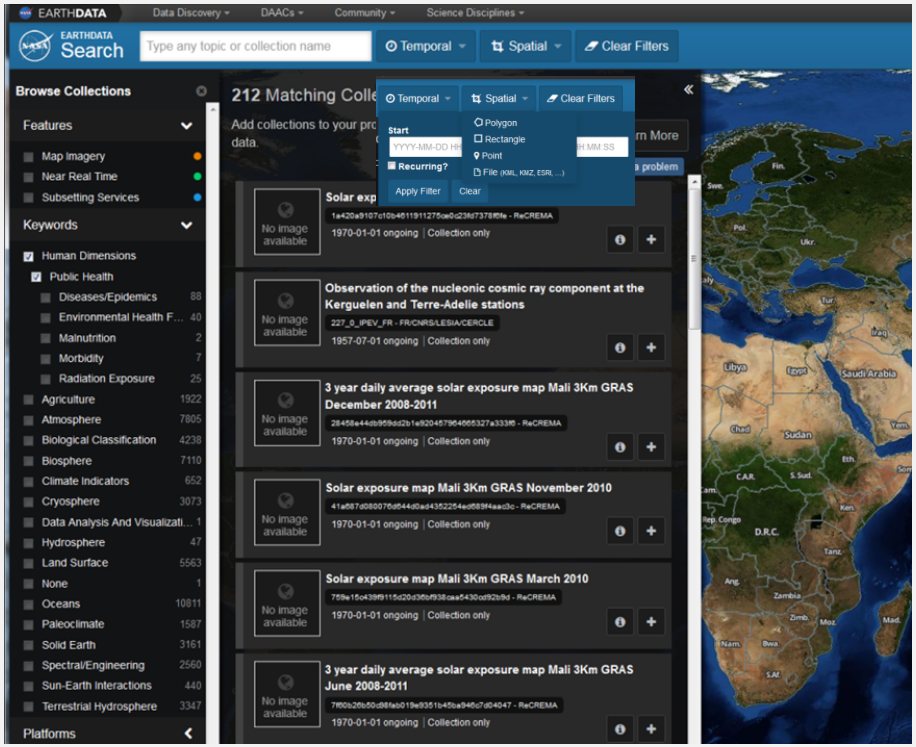
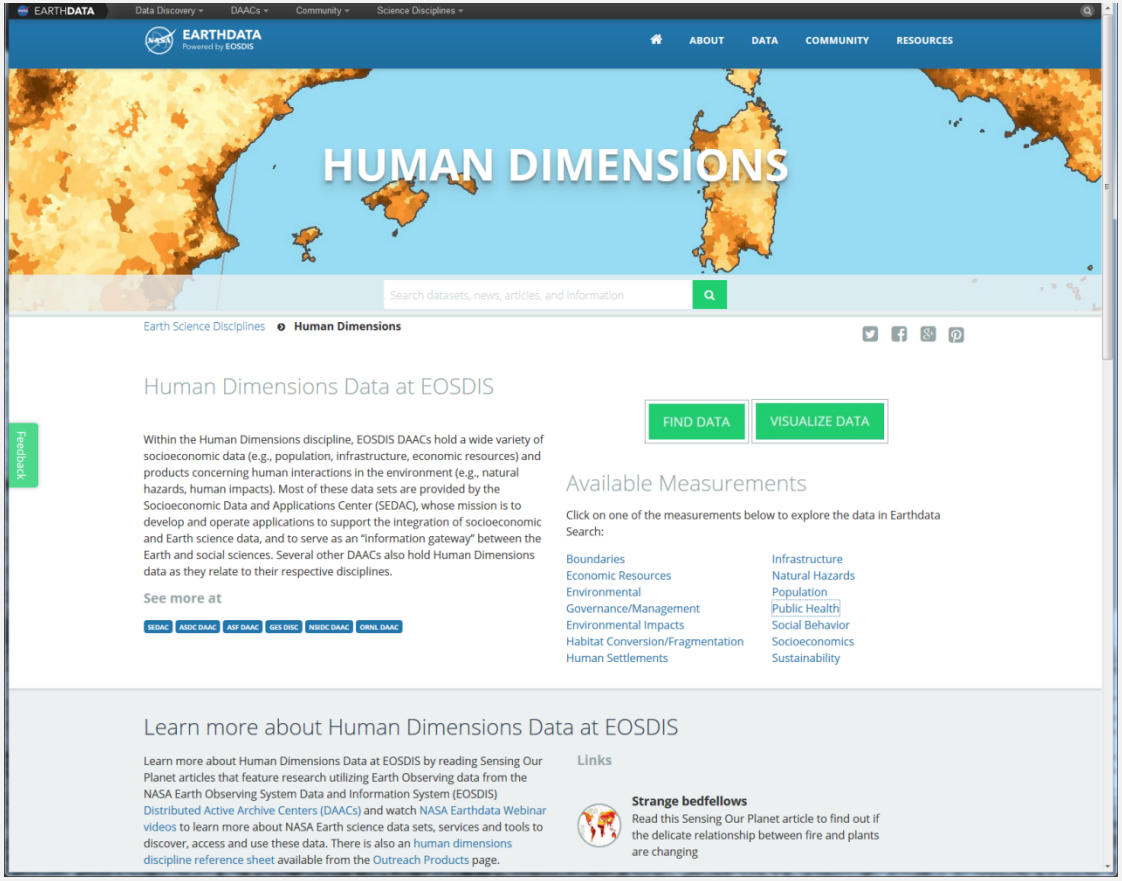
RESOURCES
Search datasets, news, articles, and information
ATMOSPHERE
CALIBRATED RADIANCE & SOLAR RADIANCE
CRYOSPHERE
HUMAN DIMENSIONS
LAND
OCEAN
Feedback
ACCESS NASA EARTH SCIENCE DATA
NASA's data policy ensures that all NASA data are available fully, openly, and without restrictions.
Here's what this means to you.
FIND DATA
VISUALIZE DATA
ABOUT EOSDIS
The Earth Observing System Data and Information System is a key core capability in NASA's Earth Science Data Systems Program. It provides end-to-end capabilities for managing NASA's Earth science data from various sources—satellites, aircraft, field measurements, and various other programs.
Webinar-Discover and Access NASA's Earth Science Data with
Tropical Cyclone Donna in the South Pacific Ocean
EOSDIS Update
SPRING 2017
Download Your Copy of the Spring 2017 EOSDIS Newsletter!

Earthdata: Public Health

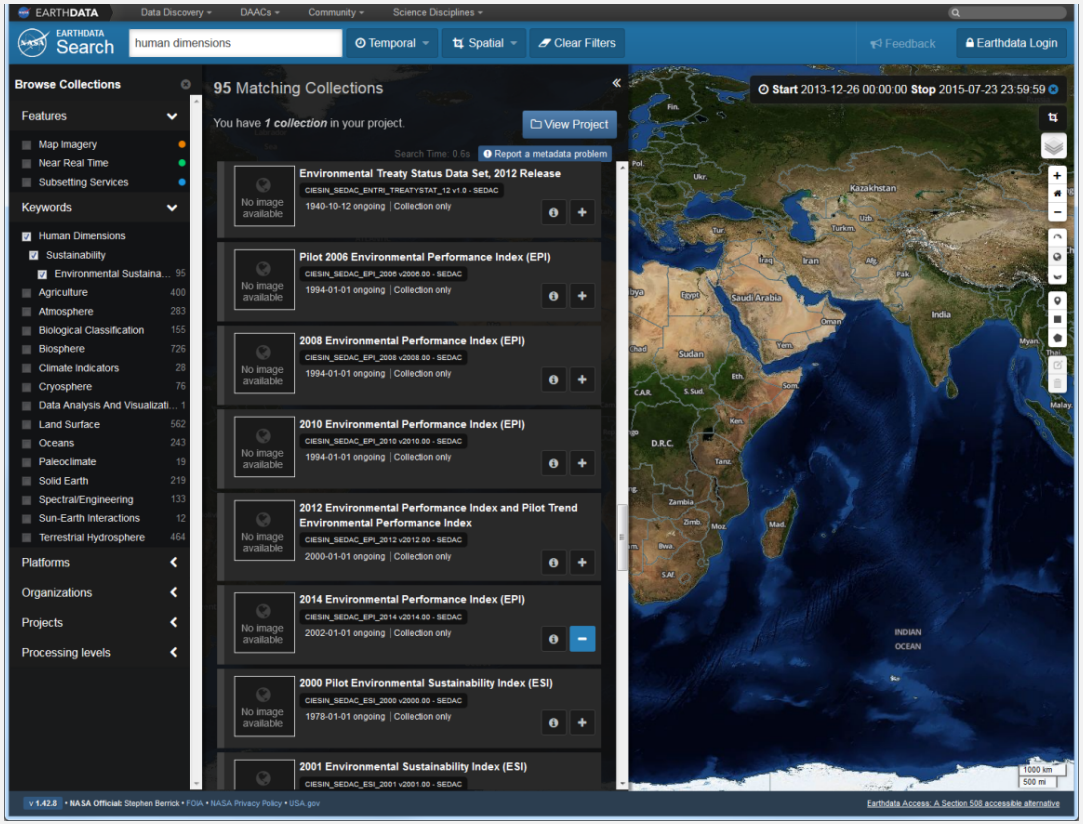


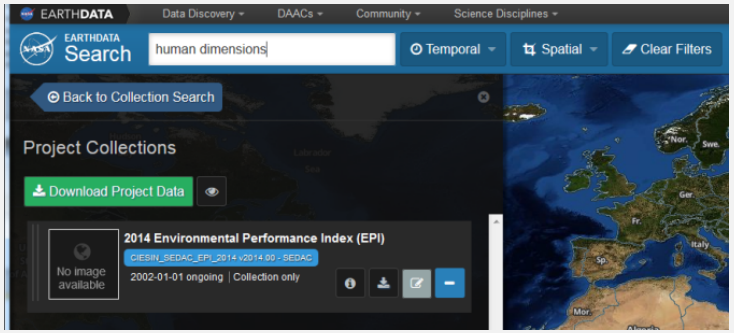


Earthdata: Human Dimensions



Earthdata: Environmental Sustainability Example





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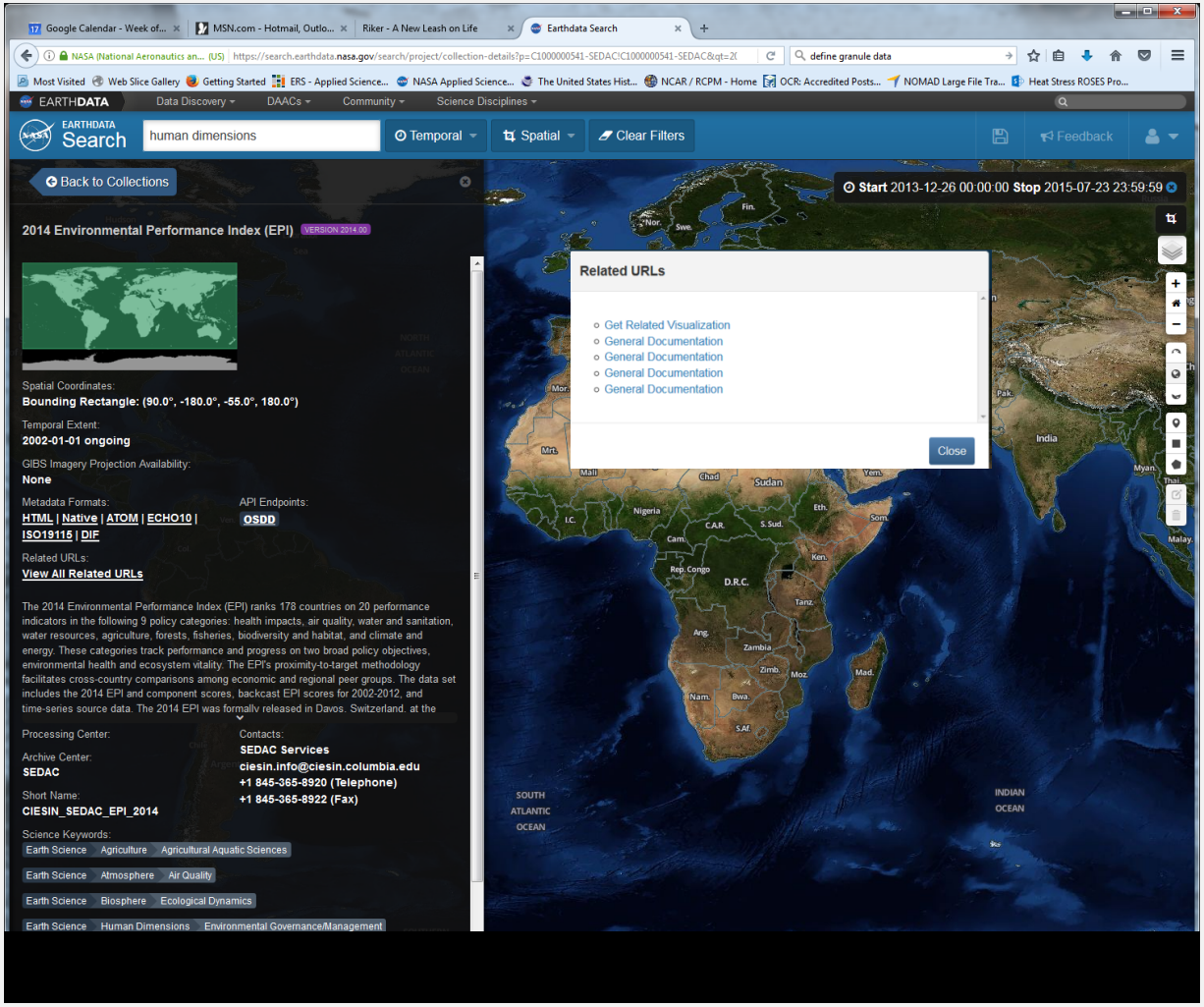
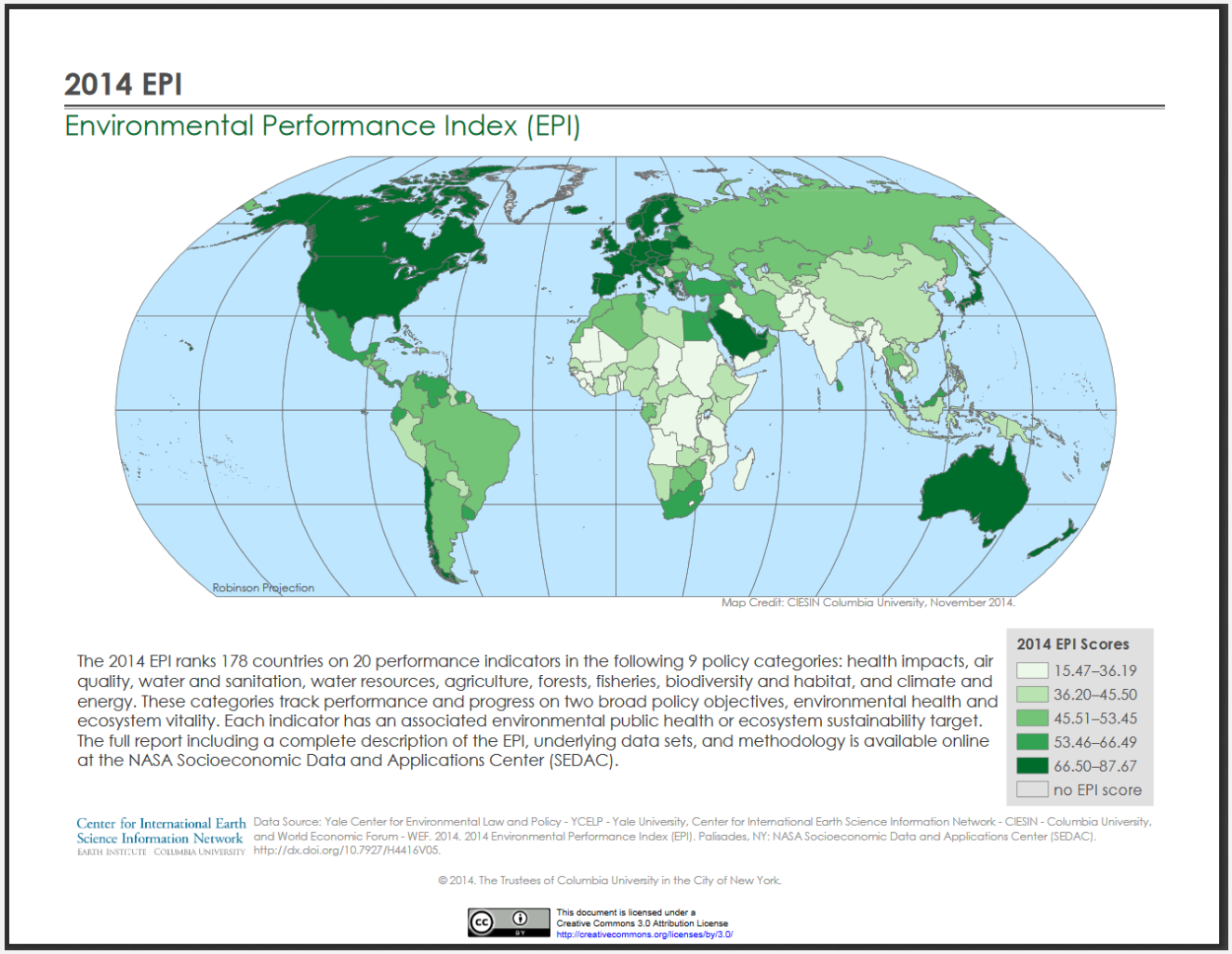


Sustainability Indicator Example



Socioeconomic Data and Applications Center (SEDAC)

Example of EPI data for one air pollutant category

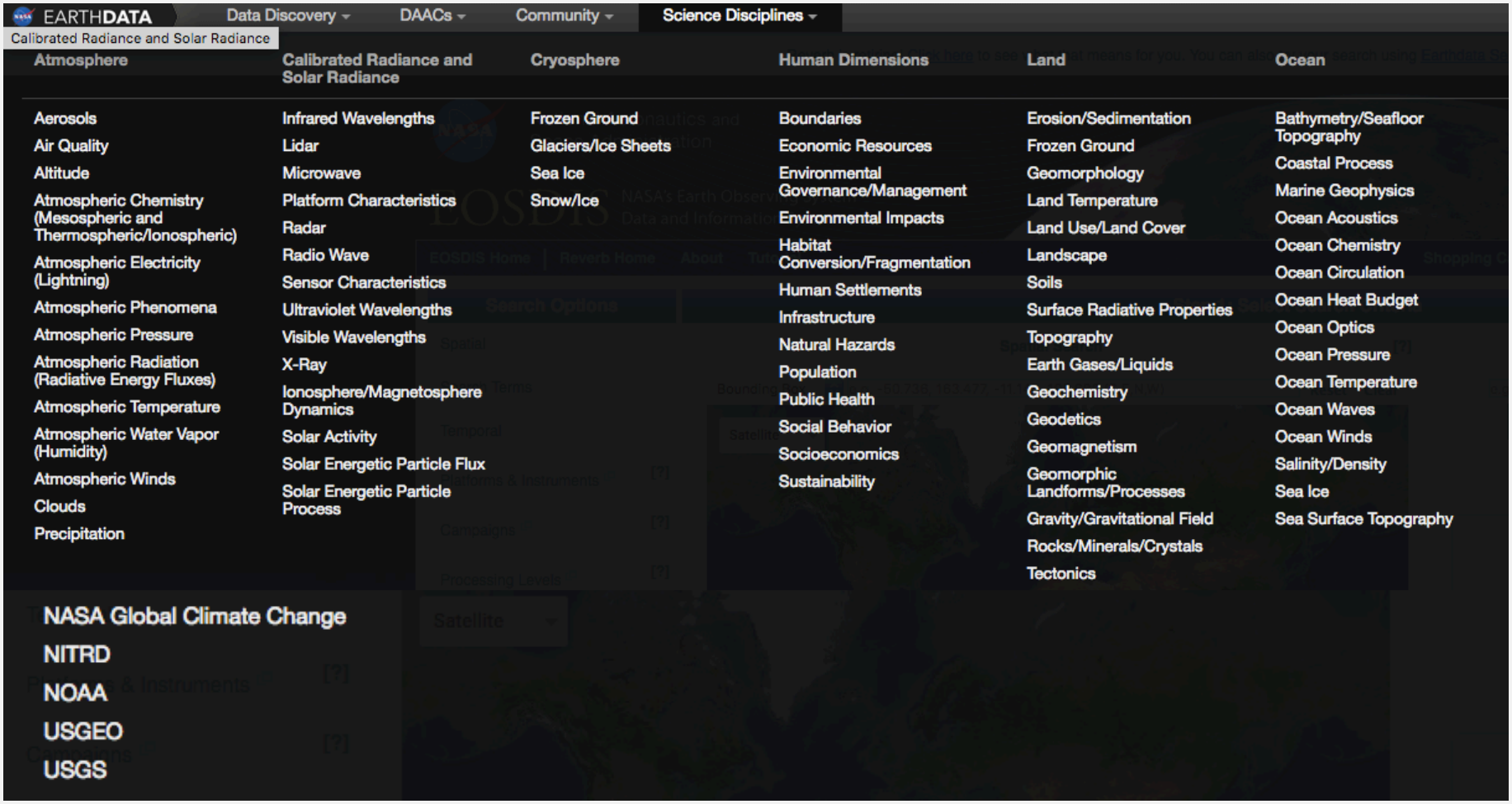
Air Pollution (PM2.5) - Population weighted exposure to PM2.5 (micro-grams per cubic meter)

Source: Aaron van Donkelaar (in prep), 2014 (embargoed)

Notes: NA = Not Applicable

Country	2000	2001	2002	2003
Afghanistan	8.6	8.42	10.64	10.81
Albania	14.73	14.6	13.79	13.77
Algeria	8.28	8.16	8.74	9.12
American Samoa	3.09	3.08	3.13	3.13
Andorra	9.3	3.59	6.66	6.41
Angola	7.85	7.74	7.59	7.86
Anguilla	0.97	0.7	0.97	0.97
Antigua and Barbuda	2.57	2.56	2.7	3.05
Argentina	5.45	5.33	5.34	5.25
Armenia	12.24	9.17	13.36	14
Aruba	4.74	4.74	3.69	3.69
Australia	3.01	2.48	3.32	3.55
Austria	16.41	15.57	15.19	16.93
Azerbaijan	12.93	12.62	11.57	10.49
Bahamas	7.2	7.12	6.31	5.93
Bahrain	8.97	8.97	10.37	10.37
Bangladesh	17	16.97	19.32	20.78
Barbados	2.89	2.88	2.99	3.2

Earthdata Menu

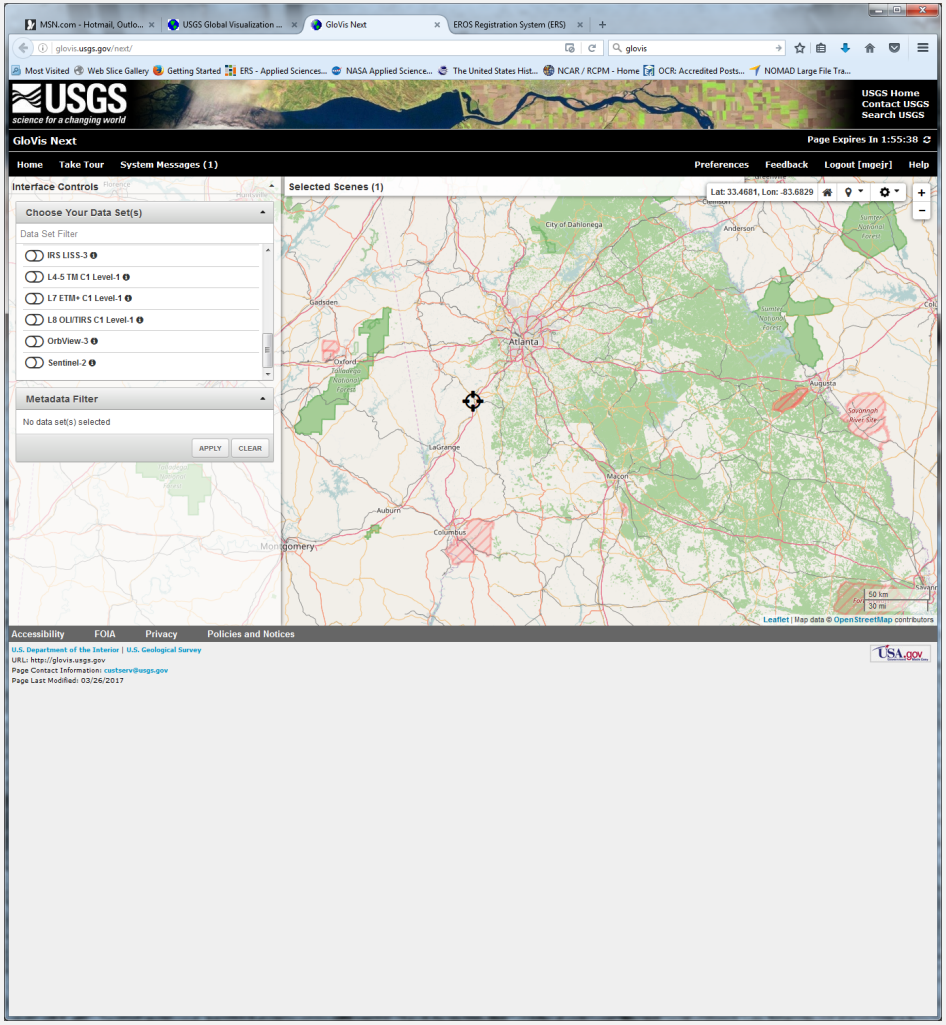


USGS Data Retrieval Tools

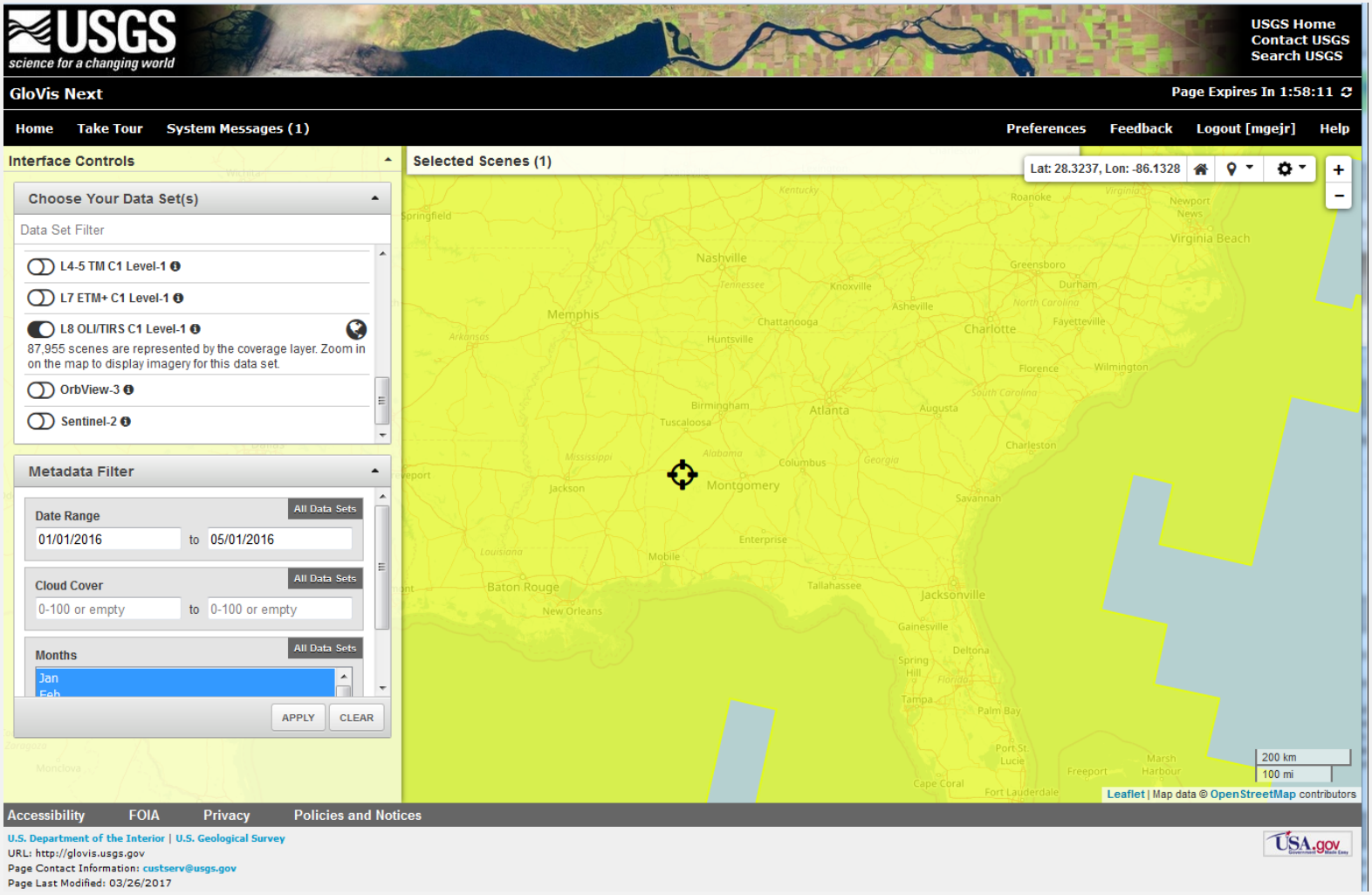
- Global Visualization Viewer (GloVis)
- Earth Explorer

USGS Global Visualization Viewer (GloVis Next)

http://glovis.usgs.gov/next/



GloVis Next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GloVis Next
Page Expires In 1:58:11
Home
Take Tour
System Messages (1)
Preferences
Feedback
Logout [mgejr]
Help
Interface Controls
Choose Your Data Set(s)
Data Set Filter
L4-5 TM C1 Level-1
L7 ETM+ C1 Level-1
L8 OLI/TIRS C1 Level-1
87,955 scenes are represented by the coverage layer. Zoom in on the map to display imagery for this data set.
OrbView-3
Sentinel-2
Metadata Filter
Date Range
All Data Sets
01/01/2016
to
05/01/2016
Cloud Cover
All Data Sets
0-100 or empty
to
0-100 or empty
Months
All Data Sets
Jan
Feb
APPLY
CLEAR
Selected Scenes (1)
Lat: 28.3237, Lon: -86.1328
Nashville
Memphis
Atlanta
Birmingham
Montgomery
Charlotte
Jacksonville
Tampa
Baton Rouge
New Orleans
Virginia Beach
Charleston
Savannah
200 km
100 mi
Leaflet | Map data © OpenStreetMap contributors
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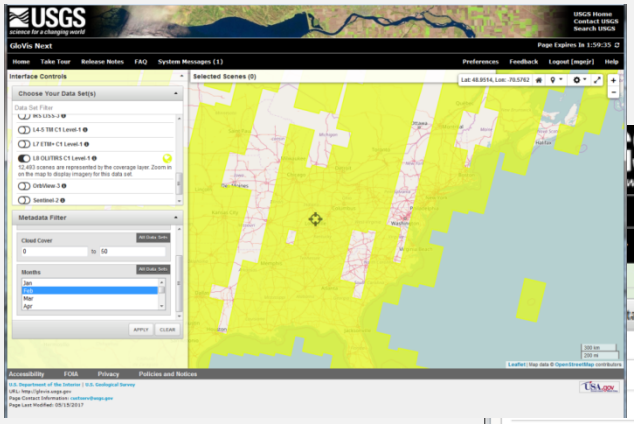
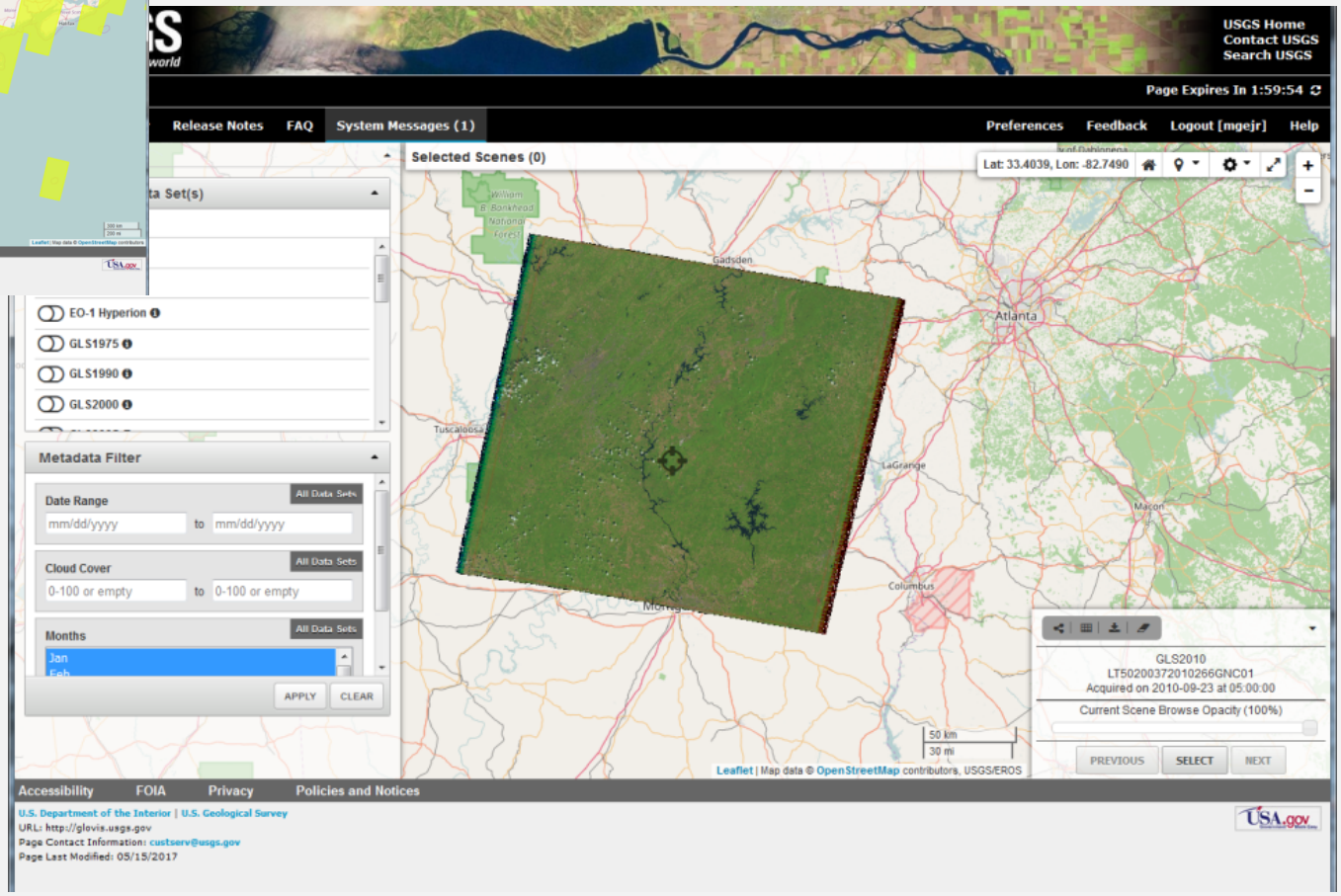
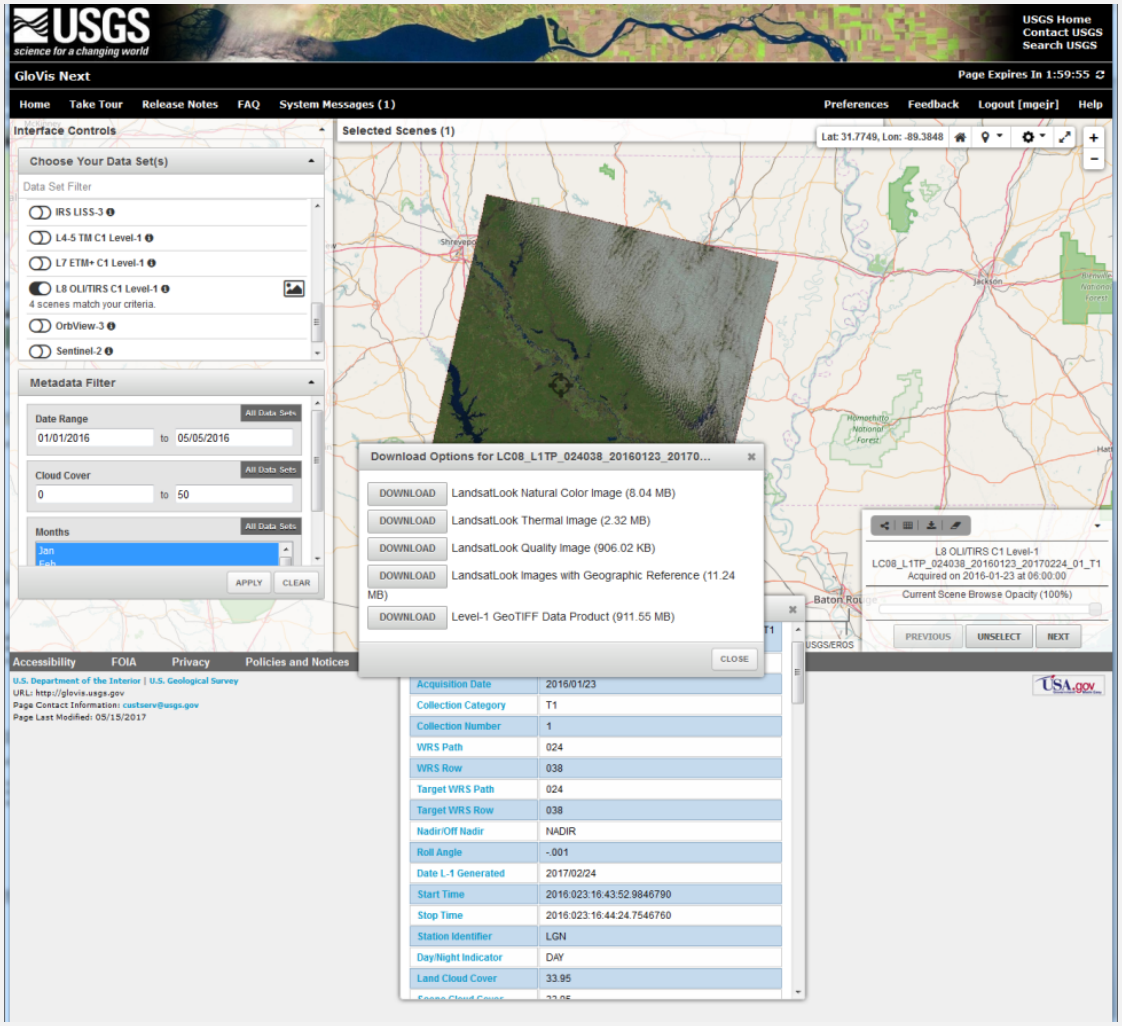
USA.gov

Coverage Area and Scene Selection





Review Metadata and Download

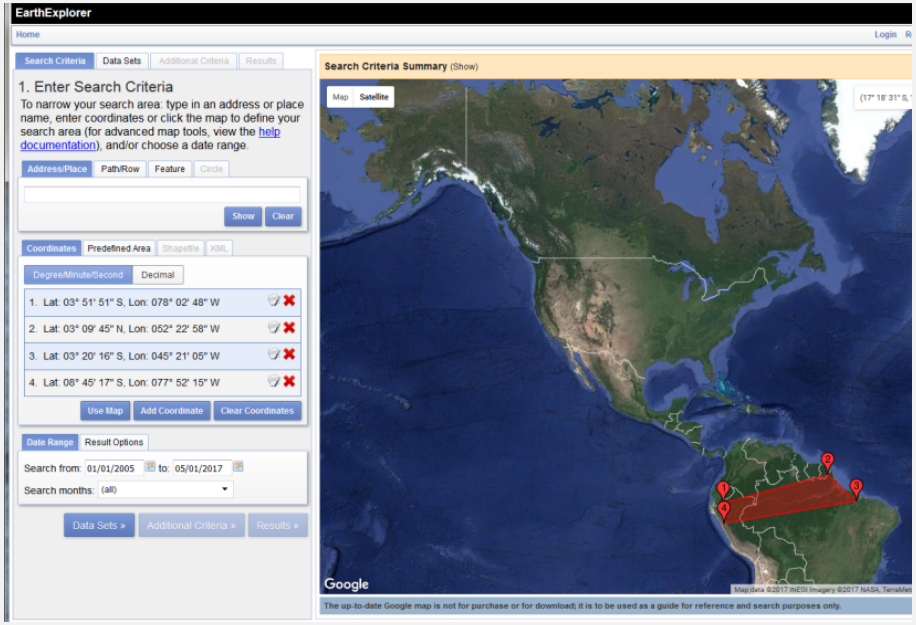


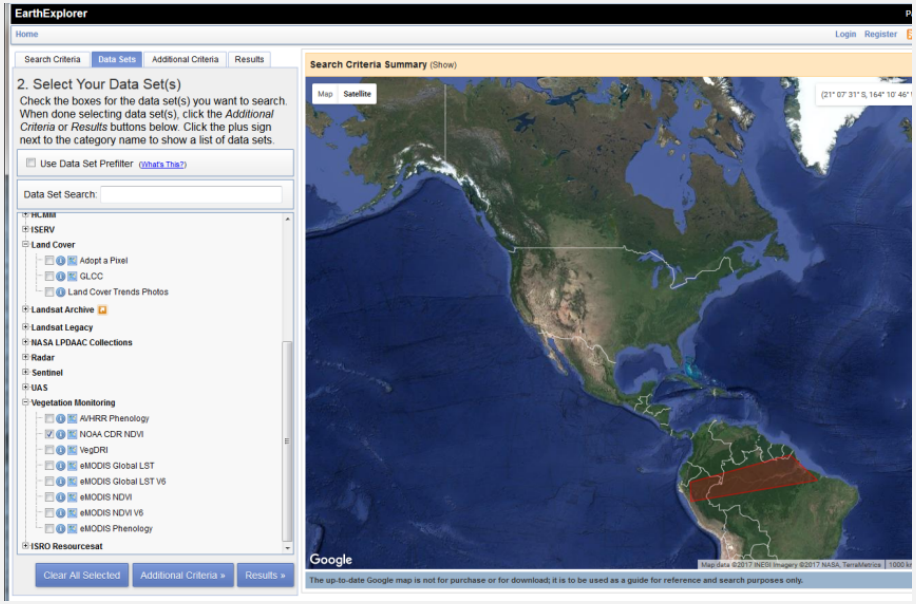
EarthExplorer (EE)

http://earthexplorer.usgs.gov/

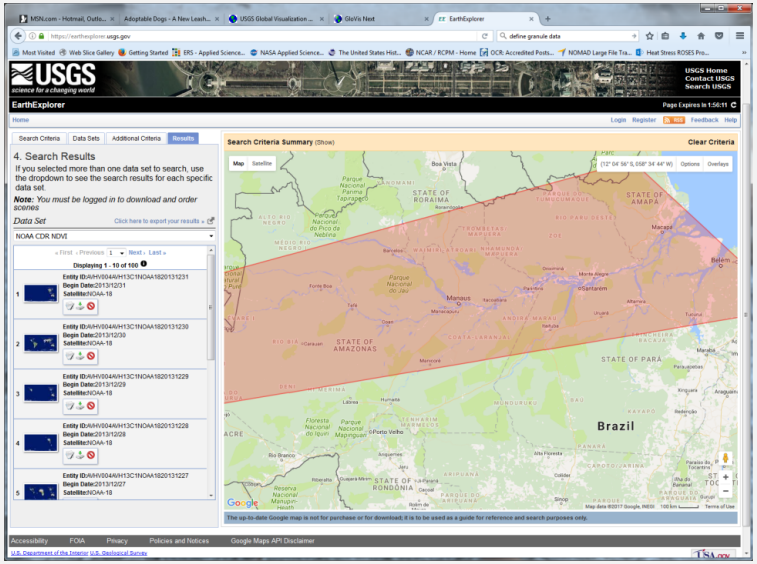
- Spatial search with map
- Select dataset
- Select results
  - Footprint
  - Browse
  - Metadata
  - Download
- Additional Criteria (cloud cover, etc.)
- Must login to download data

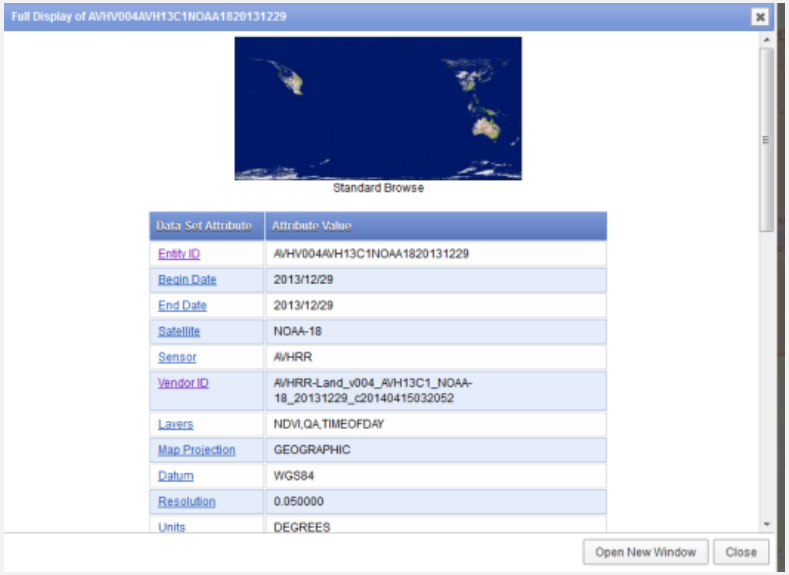
Using Earth Explorer

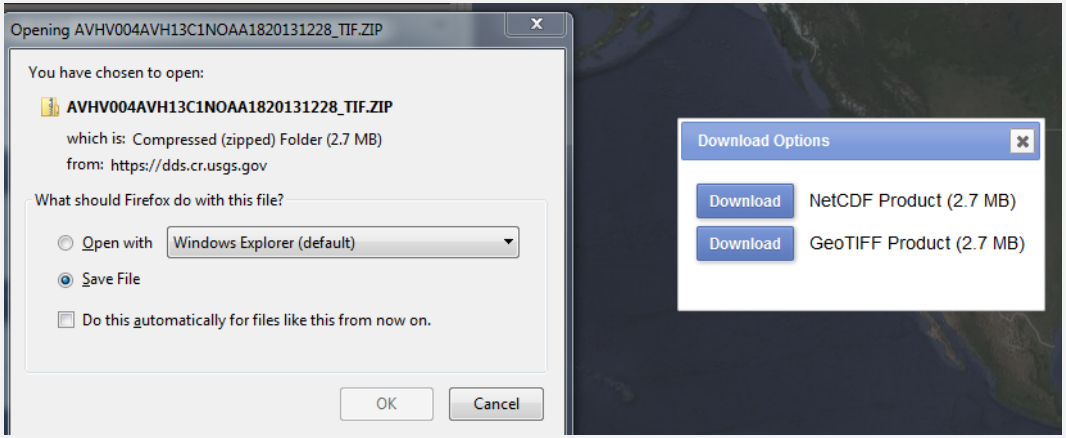




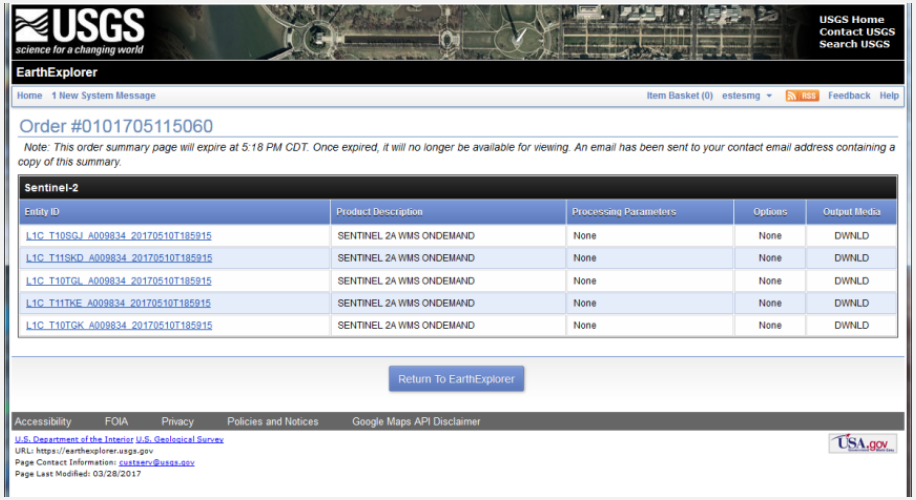
Direct Download of Files







Data Order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Order #0101705115060
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Entity ID
Product Description
Processing Parameters
Options
Output Media
L1C_T10SGJ_A009834_20170510T185915
SENTINEL 2A WMS ONDEMAND
None
None
DWNLD
L1C_T11SKD_A009834_20170510T185915
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SENTINEL 2A WMS ONDEMAND
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Return To EarthExplorer
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Search Criteria Data Sets Additional Criteria Results
4. Search Results
If you selected more than one data set to search, use the dropdown to see the search results for each specific data set.
Show Result Controls
Data Set
Click here to export your results
Sentinel-2
First Previous 1 Next Last
Displaying 1 - 10 of 100
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Acquisition Date:2017/05/10
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Coordinates:40.1176199 , -72.0093769
Acquisition Date:2017/05/10
Entity ID:L1C_T18TYL_A009832_20170510T153559
Coordinates:41.0174452 , -71.9690143
Acquisition Date:2017/05/10
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Acquisition Date:2017/05/10
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View Item Basket
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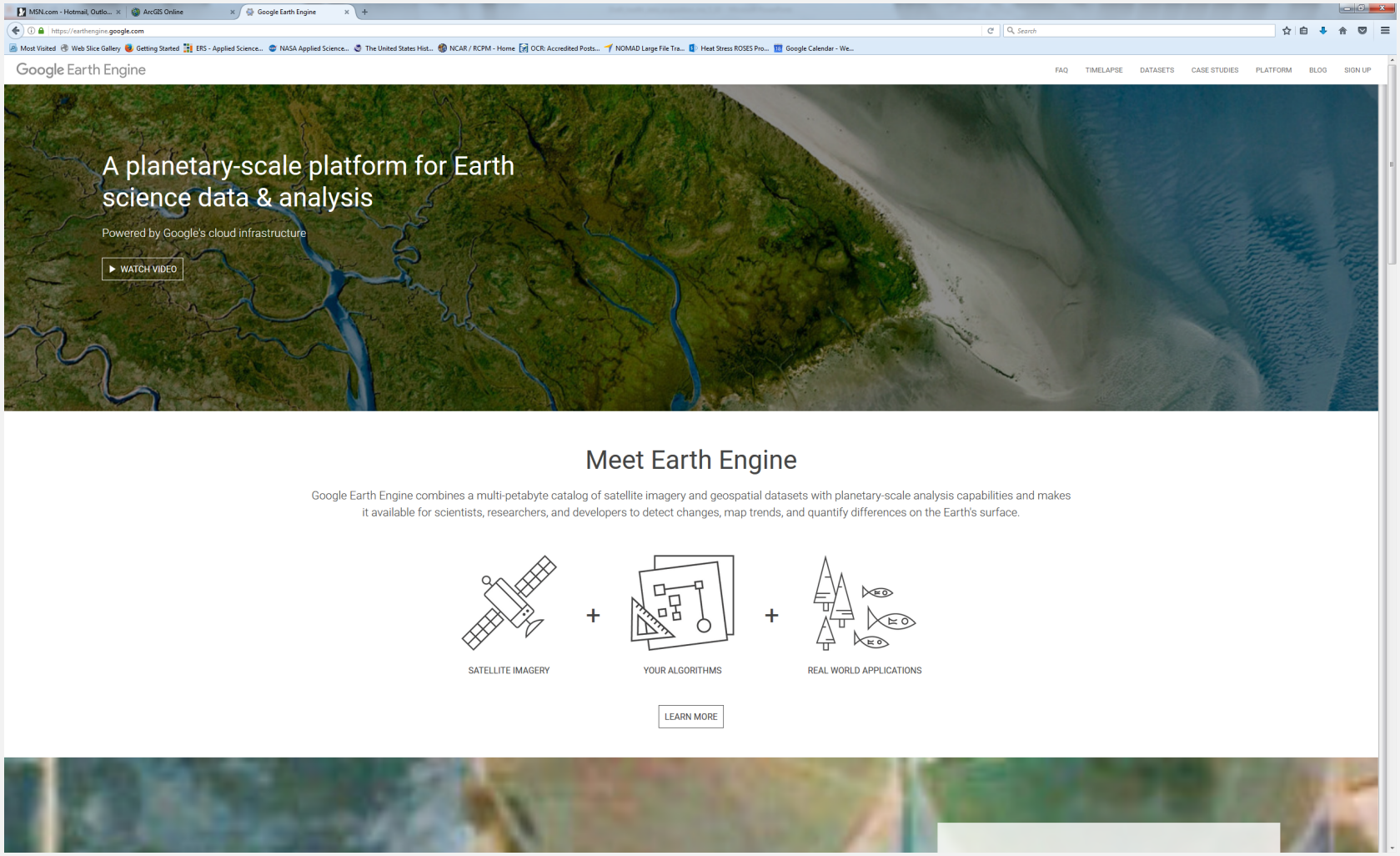
Linking Environmental and Health Data

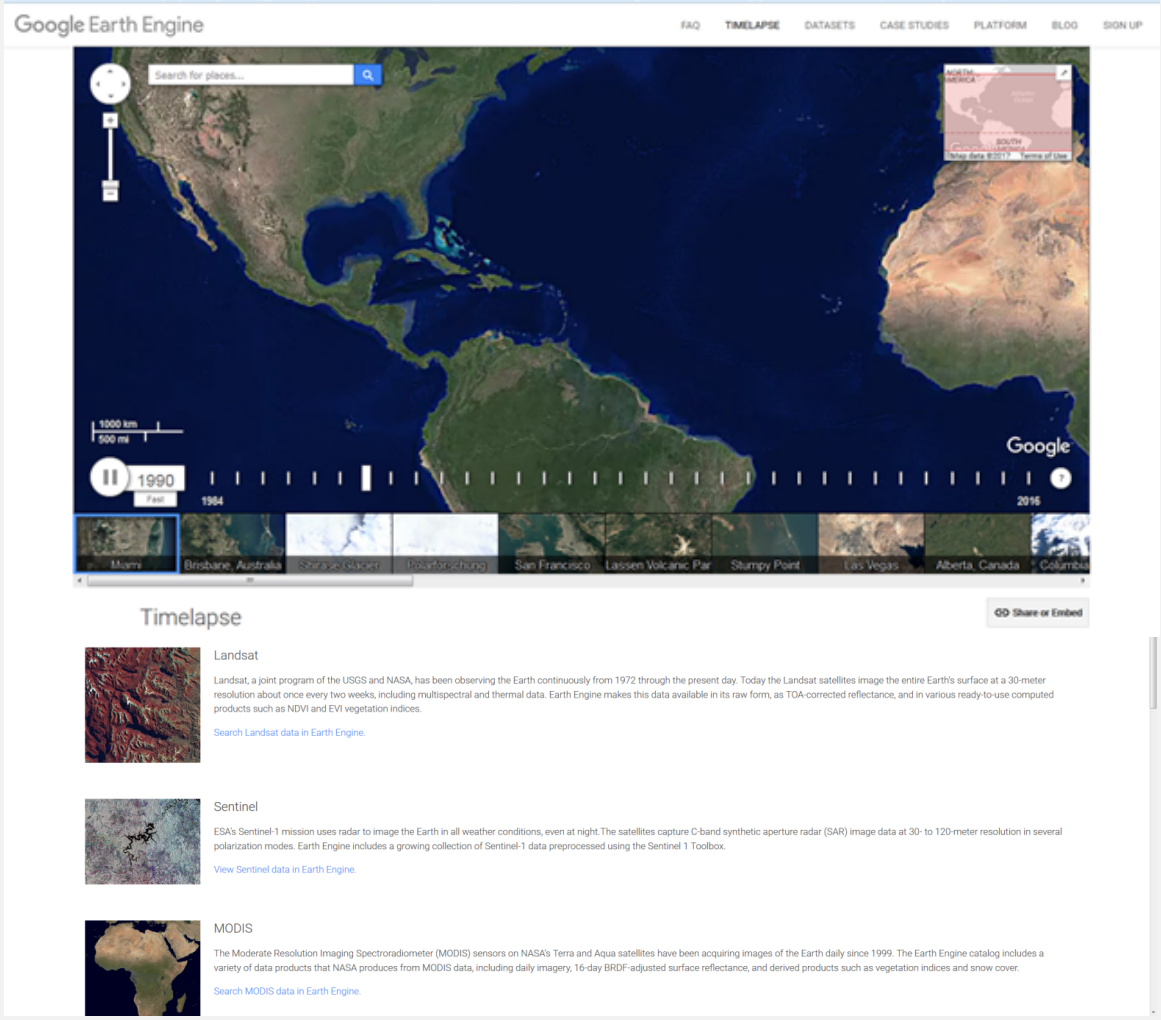
- Problem: how do I get environmental and health data in the same geographic space for analyses?
  - Open Source Geospatial Tools (R, python, etc.)
  - ArcGIS
  - ArcGIS online (https://www.arcgis.com/home/index.html)
  - Erdas/ENVI
  - ***Google Earth Engine (GEE)***

GEE

http://earthengine.google.com/



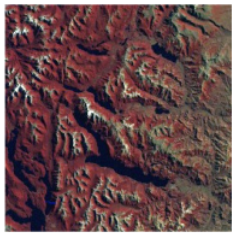
Tabs for Timelapse and Datasets



Data Catalogue

Open Sensor of Interest

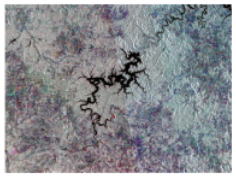
IMAGERY GEOPHYSICAL CLIMATE & WEATHER DEMOGRAPHIC



Landsat

Landsat, a joint program of the USGS and NASA, has been observing the Earth continuously from 1972 through the present day. Today the Landsat satellites image the entire Earth's surface at a 30-meter resolution about once every two weeks, including multispectral and thermal data. Earth Engine makes this data available in its raw form, as TOA-corrected reflectance, and in various ready-to-use computed products such as NDVI and EVI vegetation indices.

Search Landsat data in Earth Engine.



Sentinel

ESA's Sentinel-1 mission uses radar to image the Earth in all weather conditions, even at night.The satellites capture C-band synthetic aperture radar (SAR) image data at 30- to 120-meter resolution in several polarization modes. Earth Engine includes a growing collection of Sentinel-1 data preprocessed using the Sentinel 1 Toolbox.

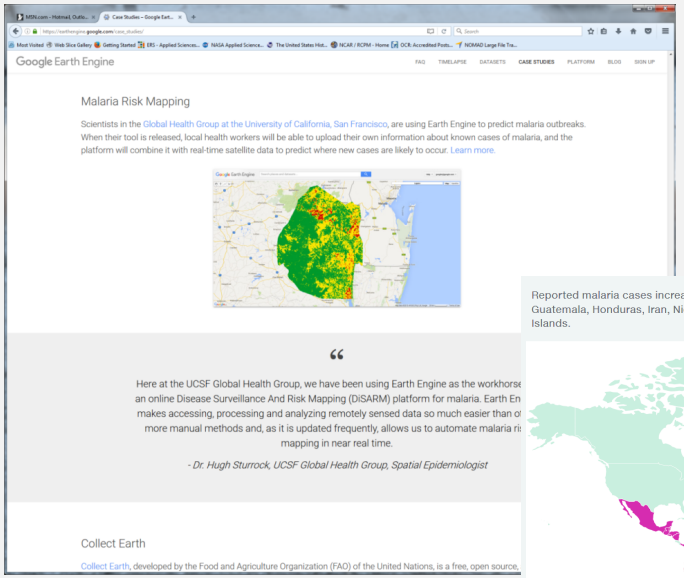
View Sentinel data in Earth Engine.

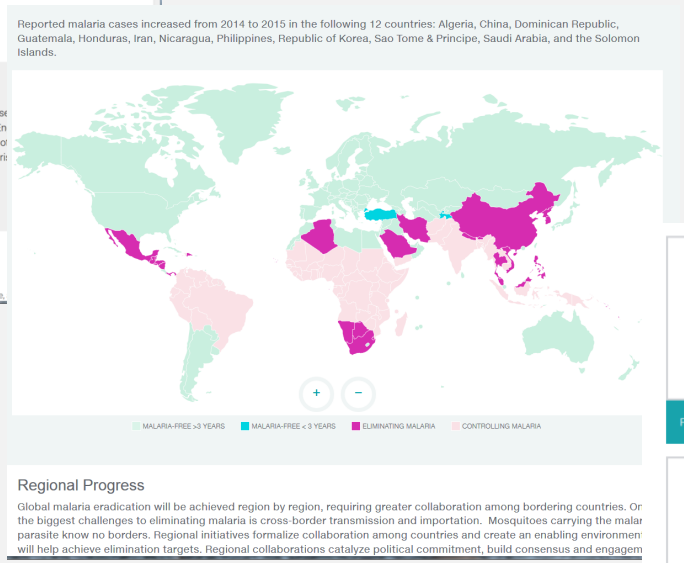
MODIS

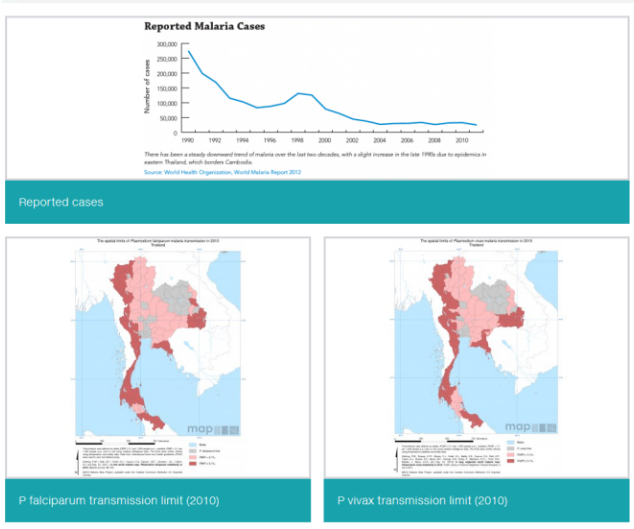
The Moderate Resolution Imaging Spectroradiometer (MODIS) sensors on NASA's Terra and Aqua satellites have been acquiring images of the Earth daily since 1999. The Earth Engine catalog includes a variety of data products that NASA produces from MODIS data, including daily imagery, 16-day BRDF-adjusted surface reflectance, and derived products such as vegetation indices and snow cover.

Search MODIS data in Earth Engine.

Case Studies



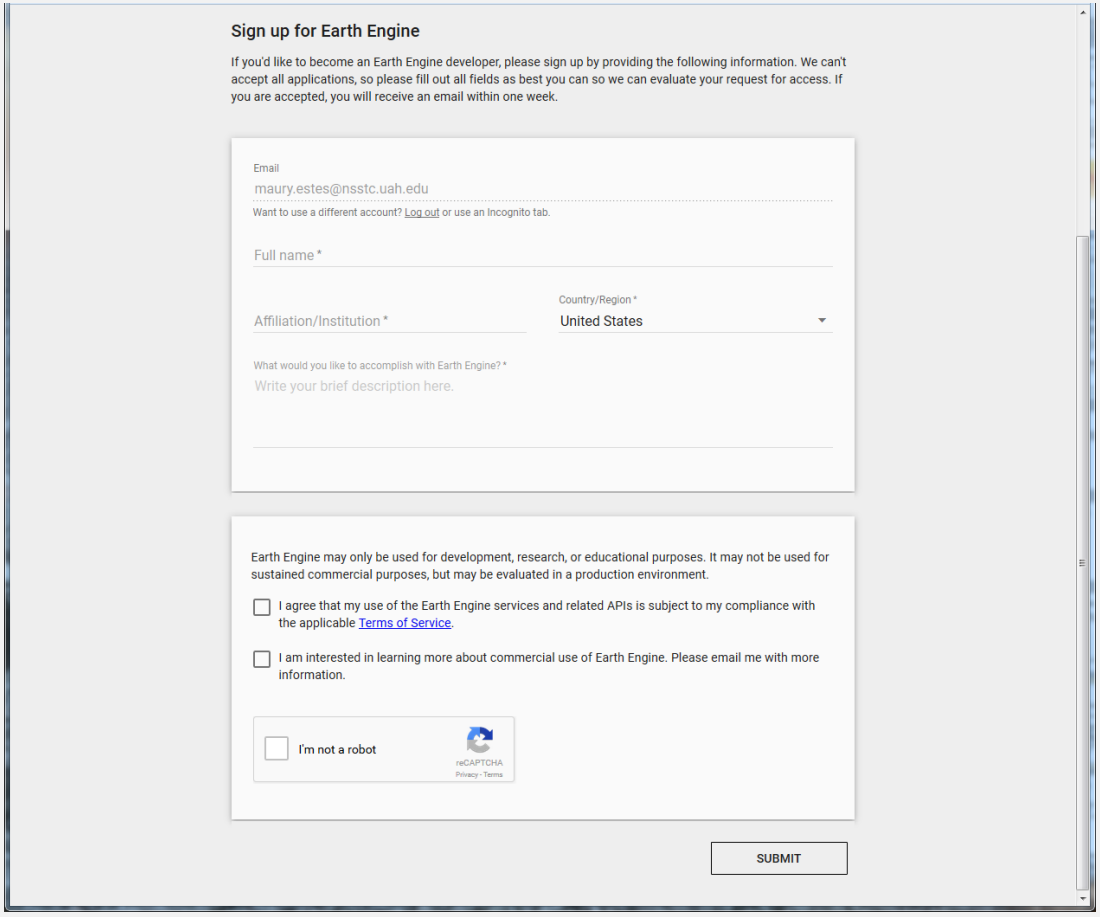




Reported Malaria cases by country in the Indonesia region

Sign up for Earth Engine

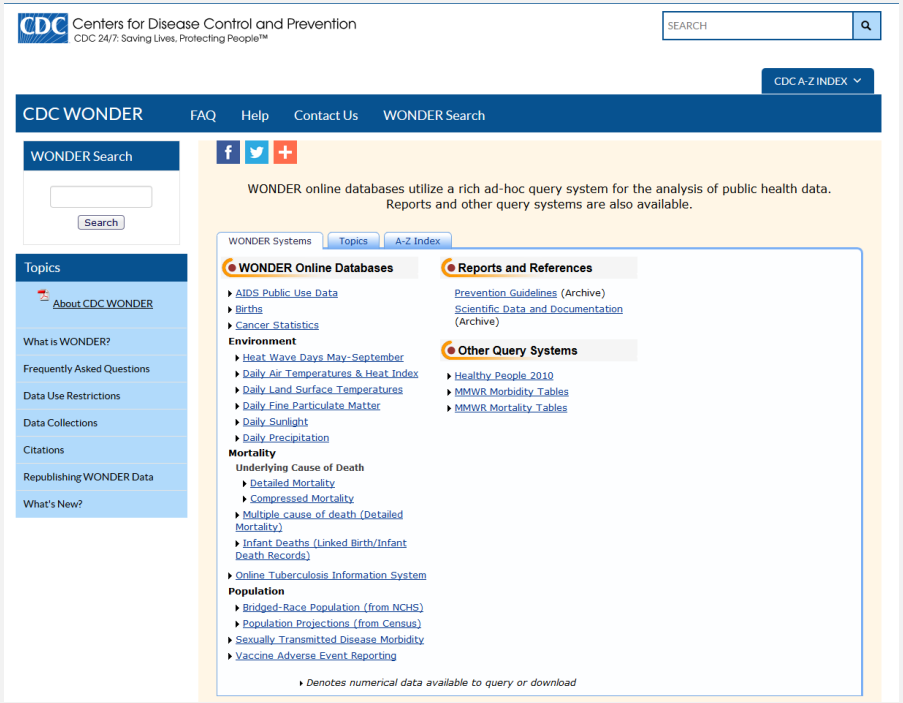
https://earthengine.google.com/signup



Earth Engine is free for research, education and non profit use

Acquiring Health Data

- **NASA doesn't collect health data**
- CDC, hospital admissions and emergency department records are good sources
- Mortality and morbidity plus location of death or illness are essential data to evaluate linkages between health outcomes and the physical environment
- **The Centers for Disease Control WONDER website** provides health data on a county wide scale for the U.S. http://wonder.cdc.gov/



Wrap-up

- Two NASA and two USGS based search and retrieval tools presented
  - All tools have features for spatial, temporal and thematic searches for data and information.
  - Which tool is best for you maybe a combination of personal preference and the type data you need.
- Google Earth Engine is a powerful resource for both data retrieval and geoprocessing analysis
  - Also a portal to various type of health related information

Homework: Reverb

1. Do a global data search, so no need for a bounding box

- Set the temporal criteria for July 1-5, 2016
- Set key science words as land surface temperature
- Select this dataset from the list: MODIS/Aqua Land Surface Temperature/Emissivity 8-Day L3 Global 0.05Deg CMG V041
- Search for granules
- Compare side by side the two browse images one from June 25 to July 2 (1st image) and the other from July 3 (2nd image) to July 10 to answer these questions:
  - Q: Is the regional temperature for the Southeast United States warming, cooling or about the same between the 2 8-day composite images?
  - Q: Is the regional temperature for north Africa warming, cooling or about the same between the 2 8-day composite images?

Homework: Search, Acquiring, and Using Earthdata

Use the EARTH DATA tool to locate the dataset for Environmental Performance Index 2014 and access the health impacts file to answer the questions below

- Q: Is child mortality higher or lower in the year 1990 in the United States of America or Guadeloupe?
- Q: Same question in 2014?

Homework: GloVis

3. Use GloVis to find a L8 OLI/TIRS scene from 2016 that has less than 10% cloud cover for Metropolitan Atlanta (all areas inside I-285, the loop road)

- Write down the Landsat Scene Identifier
- Note the Cloud Cover Percent

Homework - GEE

- 4. Use Google Earth Engine to determine the following:
  - 4a. Since 1990 when did Malaria cases peak in Paraguay, South America?
  - 4b. What was the cause of this outbreak?